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Agricultural Experiment Station
University of Kentucky

**FORESTRY IN THE ECONOMIC LIFE OF
KNOTT COUNTY, KENTUCKY.**

BULLETIN NO. 326



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Typical scene in Knott County, Kentucky, showing cleared field on steep slopes. Notice forest encroaching on field on right bank of creek in foreground. (Photo by courtesy of Bureau of Agricultural Economics.)

BULLETIN NO. 326

Forestry in The Economic Life of Knott County, Ky.¹

By RONALD B. CRAIG²

A land-economic survey of Knott County, Kentucky, was made cooperatively during the summer of 1930 by the Kentucky Agricultural Experiment Station and the United States Department of Agriculture. Its aim was to obtain as complete data as possible on the economic life of this mountain region, in the fields of agriculture, forestry, home life and standards of living, local industries, educational and religious facilities, and to correlate all these data with the utilization of the land. Cooperating bureaus of the federal government were the Bureau of Agricultural Economics, the Forest Service, and the Bureau of Home Economics.

The work of the U. S. Forest Service in this survey was concerned with a study of the forest resources, their utilization, and their role in the economic life of the county.

Methods of Forest Survey.

Information on utilization of the land was obtained by traversing all streams and side branches, including small coves. The U. S. Geological Survey topographic maps of the region were used as base, after being enlarged to a scale of 1:31,250.

¹ The writer acknowledges his indebtedness to the following men for suggestions and criticisms in the preparation of this bulletin:

Bernard Frank, Assistant Forest Economics, U. S. Forest Service; in charge of the forestry phase of the study, July-September, 1930.

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Land used was plotted on this map, using the contours on the map and the ground as determinants of type boundaries. No instrument surveying was done, as such detail was unnecessary from the standpoint of accuracy in a county of this topographic form, and impossible from the standpoint of expense. Four magisterial districts (Nos. I, II, IV, and VI), totaling 120,033 acres, or 53 percent of the county, were mapped.

Land was classified as follows: *Crop land*, being all land in crop, orchards, hay meadows, house gardens, etc., in 1930, or in either 1929 or 1928, provided such use prior to 1930 was determinable in the field; *Pasture land*, being all cleared land not in the crop classification and not bearing trees over 4½ feet high; and *Timberland*, being all other land. Four types of timber were recognized; namely, Oak-Hickory, Beech Slope, Chestnut Oak Ridge, and Yellow Poplar Cove. Each type was further classified by merchantability classes, as follows: Class A, Virgin and lightly culled old-growth; Class B, Merchantable second-growth; Class C, Non-merchantable second-growth; and Class D, Old-field, even-aged class. The first three classes are found in uneven-aged, mixed stands, while the last is found generally in pure stands of even age, which may or may not be merchantable. The average diameter range for class A runs from 8 to 40 inches or more. (One tree over 60 inches D. B. H.* was measured.) Class B runs from 8 to 24 inches, averaging about 12 inches, and class C runs from 6 to 14 inches, averaging about 8 inches. These figures vary from one type and location to another, but are a good average of the present timber in Knott County. Each class was again divided into three density classes; namely, Class 1, Fully-stocked; Class 2, Medium-stocked; Class 3, Poorly-stocked. Thus a stand might be classified as OH-C-2, a medium-stocked stand of non-merchantable oak and hickory.

Knott County lies in the southeastern section of the State, with one county (Letcher) between it and the Virginia State line. It is situated on the maturely dissected Cumberland

* Diameter breast high.

Plateau, which here has an elevation of about 1900 feet above sea-level. Elevations range from 700 feet in the northeastern section, at the mouth of Jones Fork of Beaver Creek, to 2300 feet at the head of Carr Creek, on the Letcher County line. The stream valleys are very narrow, averaging less than 500 feet, with a maximum in lower Lotts Creek of 1500 feet. The ridge crests are narrow, in many places only 50 feet wide. Slopes are very steep but frequently are broken by less steeply sloping terraces. A line from crest to crest of the ridges at right angles to the drainage averages not over half a mile in length. The general drainage of the county is east and west. The heads of the various forks of Troublesome, Lotts, and Carr Creeks mark the divide between these streams flowing westward into the North Fork of the Kentucky River, and those flowing east and northeast (Right Fork of Beaver, Caney, Jones, and Rock Creeks) into the Levisa Fork of the Big Sandy River.

The soil is typical of the whole Plateau region, varying from a fairly heavy clay loam in the saddles of the ridges to a stony or sandy loam on the slopes. The narrow bottomlands frequently have a good grade of silt loam, but the total acreage in this soil type is very small. In general it may be said that 25 percent of the county is cleared land and 75 percent is in timber. The total area of the county is 226,771 acres, and its population, as of the 1930 census, was 15,430.

In each type and class of timber, temporary sample plots were laid out for more detailed study. On these all trees over 3 inches in diameter were tallied by species, by 2-inch diameter classes, and by crown-classes. Three crown classes were recognized: Dominant and Codominant, Intermediate and Suppressed, and Defective. These terms are self-explanatory. Note was taken of the presence of trees under 3 inches, by species. The heights of a sufficient number of dominant and codominant trees were measured to permit the drawing of a curve showing the average heights for various diameters for the species represented. On about 20 percent of the dominant and codominant trees on each plot, borings were taken with a Swedish increment borer in order to determine the diameter growth during the last

decade. Total age of old-field stands was determined in like manner. The usual plot description of location, elevation, slope, exposure, type and class, history, etc., was made for each plot. In all, 136 plots were measured, divided among the four districts. Of these, 7 were reproduction plots (i. e., most of the trees were under 3 inches DBH), 15 were in old-field stands, and the remaining 114 plots were in uneven-aged mixed stands.

A study was made of the manufacture and utilization of timber and other forest products. All the sawmills in the four districts were visited, and data obtained on timberland and stumpage owned, annual output, costs of production, selling price, and forest policy, if any. Questionnaires were sent to those non-resident corporations holding 250 acres or more of land in the county which it was impossible to visit. In addition to these data, the names of the owners, acreage, and assessed valuation (both land and timber) of all holdings of 250 acres or over were obtained from the tax-rolls.

Land Utilization.

Table 1 shows the present use of land in each district. The percentage of land in each type of major use is fairly uniform for all four districts. This indicates conditions of topography, accessibility, and development over these districts, which is in accord with fact. For this reason the average percentages for all four districts combined are applied to the total area of the county to obtain the area devoted to crop, pasture, and forest. These figures are presented in the tables.

A word must be said here regarding the general system of crop rotation—or, more accurately, land-use rotation—now practiced in the mountain region. Because of the small acreage of high-grade bottom land, it has been thought necessary to put the steep mountain sides under cultivation. Slopes as steep as 75 percent were found planted to corn. Needless to say, the erosion, both sheet and gully, on such slopes is enormous and limits their arability to a maximum of fifteen years, and an economic rotation not exceeding ten years. After this period, they are allowed to revert to forest, tho generally used for

pasture for two or three years after cropping. A growth of timber—usually yellow poplar, black locust, or red and white oaks—springs up and grows rapidly. This forest, in another fifteen or twenty years, has so improved the fertility of the soil that cultivation again becomes possible, tho the yields on the second rotation in crop are never equal to those derived from virgin soil. The usual practice is to clear this land for cultivation again and start the process all over. Thus the rotation is crop, pasture, forest, crop, and so on. Obviously a limit is eventually reached where this process becomes economically infeasible. Such condition now obtains on large areas of Knott County land. This is discussed in more detail later in this report.

Table 1. LAND UTILIZATION

District No.	Crop		Pasture		Forest		Total	
	%	Acres	%	Acres	%	Acres	%	Acres
I	13	4,100	14	4,300	73	22,600	100	31,200 ³
II	14	3,800	14	3,700	72	19,700	100	27,200
IV	10	2,600	9	2,500	81	21,900	100	27,000
VI	11	3,600	16	5,600	73	25,400	100	34,600
County ⁵	12	26,800	13	39,400	75	169,400	100	226,800 ⁴

Total cleared, County: 57,200 a.; 25%. Total timber, County: 169,600 a.; 75%. (Including cut-over.)

³ Includes 156 (0.5%) cut-over land. (Cut-over 1929-30, no definite type established.)

⁴ Includes 227 (0.1%) cut-over land.

⁵ County figures are average of four districts listed, prorated over total area of county.

Present land utilization practices conduce to rapid depletion of the arable soil. This fact is recognized by the farmers, who estimate that another twenty to thirty years will see the end of the economic production of corn, the principal feed crop now raised. Hence a change of rotational practice and land utilization appears to be an immediate necessity. Inasmuch as 75 percent of the total area of the county is now bearing some form of tree growth, it is apparent that the use of this resource must play an increasing part in the economic future of this county. The composition, growth, and volume of the forest are vital factors in devising plans for its utilization.

The Forests of Knott County.

As stated, four forest types were recognized; namely, Oak-Hickory, Beech Slope, Chestnut-Oak Ridge, and Yellow Poplar Cove. Table 2 shows the proportional representation of each species of tree in each type and in the forest as a whole. This table is based on dominant and codominant trees only, and does not include those rendered defective thru disease or suppression, nor those which have not attained to dominance. One fact is strikingly brought out in this table; namely, the occurrence of most of the species in all four types. This indicates that our so-called types are really subtypes caused in large measure by artificial factors of fire, lumbering, and land clearing.

Table 2. COMPOSITION OF THE FOREST, BY TYPES

Species	Percentage of Stand ⁶				
	All Types	Oak-Hickory Type	Beech Slope Type	Chestnut-Oak Type	Yellow Poplar Type
Hickory	15.5	19.8	5.0	18.1	13.0
White Oak	15.2	27.5	9.6	4.6	0.0
Black Oak	10.3	13.6	5.4	11.8	3.3
Beech	10.2	4.7	36.0	0.0	3.9
Chestnut Oak	9.8	2.4	0.9	33.9	2.1
Red Maple	7.0	5.3	9.5	9.7	2.3
Scarlet Oak	6.7	8.8	2.8	9.1	0.0
Red Oak	5.7	8.4	2.2	4.8	3.9
Yellow Poplar	4.8	2.4	3.1	0.5	29.0
Sugar Maple	3.1	2.7	2.7	1.6	9.1
Hemlock	3.0	0.0	13.8	0.0	0.0
Basswood	1.5	0.4	1.3	0.2	10.2
Black Gum	1.3	1.3	1.5	1.6	0.0
Black Locust	1.3	0.0	0.0	0.8	8.5
Cucumber Magnolia	1.2	0.4	1.8	0.0	6.5
Others	3.4	2.3	4.4	3.3	8.2
Total	100.0	100.0	100.0	100.0	100.0

⁶ Based on number of dominant and codominant trees per acre in uneven-aged mixed stands. Boldface figures indicate predominant species in each type.

Basis: 5,170 trees on 114 plots.

The timber of this region is predominantly oak and hickory. These form over 63 percent, and beech and poplar 15 percent of the total stand, based on the number of trees. The remaining 22 percent consists of a large number of species, only one of which (red maple, 7%) occurs in an amount greater than 3½ percent. At present, living chestnut forms about 15 percent of

the chestnut-oak type, but fully 9 percent of it is infected with the fatal chestnut blight, and will die within the next five years. If immediate utilization of this species were possible, much of it could be salvaged, but it is rapidly passing out of the picture so far as the future forest is concerned, and for that reason it is not considered in the tables herein. Table 2 is based on the uneven-aged, mixed stands only, and does not include the old-field stands, most of which are pure stands of poplar, locust, or oaks and hickory, or more rarely of beech, red maple, buckeye, and red gum.

The topographical location of the four types is usually as follows: The Chestnut-Oak Ridge type, as its name implies, occupies the crests of the narrow ridges above 1600 feet, and on higher ridges extends down the slope to about this same elevation. From this point down to about 1250 feet the Oak-Hickory type occurs, and also on the crests of ridges below 1600 feet. From 1250 feet down to the creek level, the Beech Slope type is found. The Yellow Poplar Cove type occurs generally as an old-field association, altho remnants of the original forest of this species and its associates are still to be found in wet coves at all



Virgin Chestnut-Oak Type on ridge south of Troublesome Creek. Species represented are chestnut-oak, black oak, red oak, and hickory. Average D. B. H. = 14 inches. (Forest Service Photo No. 247033.)

elevations, especially in those coves facing north and east. On the north nose of sharp spurs, the Beech type frequently runs from creek level to the Chestnut-Oak type, replacing the Oak-Hickory. On the higher mountains above 1900 feet, pine (chiefly Virginia pine, with smaller amounts of both pitch and shortleaf) forms at times a considerable portion of the Chestnut-Oak type, especially on south and west slopes. A very limited area is covered by a river-bottom type not recognized in the survey, consisting of sycamore, red birch, and willow. Intergradation of types is common, especially in older stands, and makes the determination of exact type boundaries extremely difficult.

The distribution of the timber by types and by merchantability class in each district is shown in tables 3 and 4. The distribution of the merchantability classes by types is fairly uniform. There is less uniformity in the distribution of the timber among the four merchantability classes. There seems here to be a more or less direct correlation between distance from market and area of merchantable timber. Districts IV and VI lie nearest to a railroad and are also served by a reasonably good highway. These two districts have the least area in merchantable timber. On the other hand, District I, which is farthest from a railroad, has the largest area in this class. District II, part of which is inaccessible, but the rest of which has access to a State highway, also has a large area of good timber. This is also partially explained by the large acreages in this district being held by non-resident corporations which are reserving their timber. Another unquestionable factor thruout the whole county is the personal inclination of the individual owner to sell or retain his timber.

Table 5 shows the quantity of timber in board feet now standing in each district and in the county as a whole, by types and by merchantability classes. This volume represents only the dominant and codominant trees, and does not include the suppressed or defective trees. Based on the number of trees, 58 percent of the total stand is defective. This will be discussed later, but is mentioned here merely to show that, were immediate

utilization of timber possible, the total stand would have to be increased to about 1,250,000,000 board feet. Since this degree of utilization is not at present possible, and since whatever growth the present forest makes will be on the dominant and codominant trees, the smaller figure (788,900,000 board feet) is used as the basis of the discussion of the part which forestry will play in the county's future. About 44 percent of this total volume is in the Oak-Hickory type, 28 percent in the Chestnut-Oak type, 20 percent in the Beech type, and 8 percent in the Yellow Poplar type.

Table 3. DISTRIBUTION OF TIMBER BY TYPES

District No.	Oak-Hickory		Beech Slope		Chestnut-Oak		Yellow Poplar		Total Timber	
	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres
I	55	12,500	21	4,800	18	4,000	6	1,300	100	22,600
II	48	9,400	18	3,600	25	5,000	9	1,700	100	19,700
IV	56	12,200	27	5,900	12	2,700	5	1,100	100	21,900
VI	54	13,600	24	6,200	15	3,900	7	1,700	100	25,400
County	53	90,200	23	38,800	18	29,500	6	10,900	100	169,400

Table 4. DISTRIBUTION OF TIMBER BY MERCHANTABILITY CLASSES

District No.	Old-Growth		Merch. 2d Gr.		Non-Merch. 2d Gr.		Old-Field		Total Timber		% Merch.
	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	
I	2	400	57	12,900	33	7,300	8	2,000	100	22,600	59
II	1	300	43	8,300	44	8,700	12	2,400	100	19,700	44
IV	1	200	41	8,900	50	11,000	8	1,800	100	21,900	42
VI			9	2,300	85	21,500	6	1,600	100	25,400	9
County	1	1,400	36	61,900	54	91,600	9	14,500	100	169,400	37

For all districts other than VI which were intensively surveyed, more than 50 percent of the present stand is now merchantable. (See Table 5.) The percentage is even larger if the large volume of defective, over-mature timber is added to the volume shown in the table. In district VI and portions of districts III and V most of the timber is in the non-merchantable class, and in district VII about 50 percent is now merchant-

able. For the county as a whole, the table shows a merchantable volume of approximately 511,000,000 board feet, or 65 percent of the total volume.

Table 5. PRESENT STAND OF TIMBER

Type and Class	Dist. I	Dist. II	Dist. IV	Dist. VI	County	Percent
	Present Volume in Thousand Board Feet ¹					
Oak-Hickory	57,200	39,600	51,000	36,300	345,700	44
A ²		1,300	900		3,600	
B	44,200	26,600	33,000	9,700	214,800	
C	12,000	10,600	16,500	25,900	120,700	
D	1,000	1,100	600	700	6,600	
Beech-Slope	30,200	12,000	26,100	17,900	159,600	20
A	3,100	400	2,300		9,600	
B	22,200	3,200	12,800	1,900	74,100	
C	4,300	8,200	10,700	15,800	73,400	
D	600	200	300	200	2,500	
Chestnut-Oak	36,400	40,700	23,200	15,800	221,500	28
A		1,700			2,850	
B	35,800	36,300	23,000	5,800	193,500	
C	600	2,700	200	10,000	25,000	
D						
Yellow Poplar	6,600	9,500	5,400	8,800	62,100	8
A	3,000				4,300	
B	1,700	2,000		600	8,400	
C	1,000	8		3,500	9,700	
D	900	7,500	5,400	4,700	39,700	
Grand totals	130,400	101,800	105,700	78,800	788,900	100

¹ Based on volume by International $\frac{1}{4}$ " Rule (excluding a one-foot stump and to a 5-inch top diameter inside bark) of all dominant and codominant trees 8 inches and over, diameter at breast height.

² Less than 100 M. B. F.

³ Class A—Virgin; B—Merchantable second growth; C—Non-merchantable second growth; D—Even-aged, old-field.

Note.—Gross stand of all trees, including suppressed and defective, is about 1,250,000 M. B. F.

Summary by Merchantability Classes for County

Class	Vol. in M. B. F.	Percent	
A	20,300	3	} 511,100 M.B.F.—65%—Merchantable
B	490,800	62	
C	229,000	29	} 277,800 M.B.F.—35%—Non-merchantable
D	48,800	6	
Total	788,900	100	

Before entering upon a discussion of these tables, it is necessary to add one more (Table 6), showing the average stand per acre, the annual growth per acre (i. e., what each acre adds each year to its volume), and the total volume thus added for each type and class and for the forest as a whole. These figures are a very vital factor in determining the amount of feasible utilization. The great bulk of present utilization comes from the uneven-aged, mixed stands, as most of the old-field stands are too young to be of immediate value.

The average stand per acre is 4700 board feet, the annual growth on one acre is 140 board feet, and the total annual growth for all types and classes is 24,400,000 board feet. This figure for total growth is obtained by multiplying the average annual growth of each type and class by the number of acres in that type or class. The column headed "Percent" is the percentage increase per year for the past decade. This is obtained by dividing the actual increase in board feet since 1920 by the volume present in 1920, and again dividing by 10 and multiplying by 100. It is given here as being the most reliable figure by which



Merchantable Second-Growth Beech Slope Type, Lower Mill Creek of Troublesome Creek. Species represented are beech, history, and red maple. Average diameter 12 inches. (Forest Service Photo No. 248486.)

to prognosticate future volume. For example, a stand is classified as OH-B. Its present volume is found to be 8000 board feet per acre. From this table its annual growth percent is read as 2.4. Then, in 1940, its volume should be approximately 9900 board feet per acre ($8000 + (8000 \times .24)$). In this way, knowing the classification of a given stand and its present volume, its approximate volume for the next one or two decades can be estimated.

Table 6. AVERAGE STAND AND ANNUAL GROWTH, BY TYPES

Type and Class	Average Stand Per Acre (Thousand Bd. Ft.)	Rate of Annual Growth (Thousands Board Feet)		
		Per Acre ¹⁰	Total	Percent
Oak-Hickory		120	10,000	
A	15.9	180	¹¹	1.1
B	7.0	170	5,200	2.4
C	2.2	80	4,200	3.6
D	1.4	130	600	¹²
Beech Slope		120	4,200	
A	14.1	290	200	2.1
B	7.8	130	1,200	1.7
C	2.7	100	2,600	3.7
D			200 ¹³	¹²
Chestnut-Oak		200 [†]	6,000	
A	12.3	250	100	2.1
B	9.3	250	5,200	2.7
C	3.0	80	700	2.7
D				
Yellow Poplar		370	4,200	
A	18.9	400	100	2.1
B	9.3	270	300	2.9
C	5.3	230	400	4.3
D	5.0	430	3,400	¹²
Total	4.7	140	24,400	-----

¹⁰ Average over last 10 years.

¹¹ Less than 100 thousand board feet.

¹² For data on old-field stands, see Tables A and B in the Appendix.

¹³ On assumption that the annual growth for this type equals that for the Oak-Hickory type.

For the even-aged, old-field stands, data sufficient to construct yield tables were obtained on only the Yellow Poplar and Oak-Hickory types. No old-field stands of Chestnut-Oak were

found, the several pure stands of Black Locust were found in the normal habitat of this type. The old-field class in the Beech type is closely associated with the same class in the Oak-Hickory type, and the yield table for the latter applies roughly to Old-Field Beech. In constructing yield tables, the sites were classified on the basis of the average height of the dominant trees on the plots. (See Table A and B in the appendix.)

Forest History of the County.

The Cumberland Plateau region of Kentucky was first settled about 1810-1820, at which time it contained, along with the whole Ohio Valley area, what was probably the finest stand of hardwood timber on this continent. The original forest presumably covered the entire area of what is now Knott County, with approximately the same proportion of species as at present, except that there were more poplar, walnut and, perhaps, white oak. The total stand was probably close to $3\frac{1}{2}$ billion board feet. Some land was cleared for crops, and the timber used for construction of the cabins and sheds of the settlers. As population increased, the cleared area increased rapidly until a few years ago, since which time it has remained fairly constant, because the reversion to forest of land no longer arable has just about offset the clearing of small additional areas of forest for crops. In the decade, 1890-1900, lumbering began on a larger scale in the county. About all the timber that was taken out, however, were the poplar, walnut, and white oak trees above 18 inches in diameter on the stump. This practice still guides the industry in the region, altho more species are cut and the cutting limit has fallen to 12 or 14 inches on the stump. In certain areas, and coincident with the coming of the railroads and the opening of the mines, closer utilization has taken place, trees down to an 8-inch stump being cut for mine timbers. These areas, however, are confined to those portions of the county nearest the two railroads, the Louisville & Nashville in the valley of the North Fork of the Kentucky River, and the Chesapeake & Ohio in the Beaver Creek valley.

The original method of logging was to skid the logs to the stream bank and build a splash dam below the logging area. The logs were then rolled into the pond and at high-water in the spring the dam was blown out and the logs "splashed" down to the rivers or mills on the railroad. Loss from breakage and from "hanging" on the stream banks was, of course, very large, but the timber was believed to be inexhaustible, so little attention was paid to this loss. With the coming of better roads and the motor truck, this practice was abandoned, and most of the timber cut in the county is now sawed at local mills and the lumber hauled to market or railroad by truck.

Little attention has been or is now paid to fire prevention, nor, until late years, to fire control. It is an interesting fact that very few serious fires covering large areas have occurred in the county in the past fifteen years. The forests bear strong evidence of the devastation wrought by earlier fires. As stated previously, 58 percent of all the trees measured (over 18,000) were found to be defective. Fully 50 percent of this defect was fire-caused, the balance being chiefly attributable to chestnut blight. The causes of past fires were brush-burning, smoking, and deliberate incendiarism. No attempt was made to extinguish a fire once started, so burned areas frequently totaled thousands of acres. With the discovery and development of valuable deposits of coal in the county, fire control became advisable, and the present attitude is strongly in favor of immediate suppression. To be sure, the average owner, either corporate or individual, is more interested in the coal than the timber, but the result is the same.

Insect damage is, so far, apparently negligible. Some slight infestations of locust borer were seen, but nothing approaching serious proportions. With the exception of the chestnut blight, no serious fungus diseases were noted. Fully 90 percent of the chestnut is now infected with the blight, and at least 35 percent of the standing trees are dead or nearly so. As stated heretofore, another five years will see the end of this species as a living tree in Knott County.

Production of Lumber and Other Forest Products.

Because of the depression in both the lumber and the mining industry in 1929-1930, the total production probably fell below that of the normal years. The average for the past two years was 6,614,000 board feet, divided as follows:

Sawed lumber, including mine timbers.....	5,480,000 B. F.
Cross-ties	7,348 pieces..... 294,000 B. F.
Staves	1,050,000 pieces..... 840,000 B. F.

In this connection, it is interesting to note that a report¹⁴ published in 1908 gives 5,370,000 feet as the annual production of this county. Of the current total, about 5,270,000 feet is shipped out of the county, leaving 1,344,000 feet for local consumption, or slightly over 88 board feet per capita.

There is an additional drain on the forest for timber for farm repairs and maintenance (fences, corrals, new log buildings, firewood, etc.), estimated at 750,000 board feet, and for the timber destroyed in logging and in clearing land for crops, estimated at 1,000,000 feet a year. The total drain on the forest is, therefore, about 8,400,000 board feet a year, or about one-third of the annual growth.

A more critical analysis of these data is required, however. Nearly 90 percent of the present cut is from the Oak-Hickory type, of which the annual growth totals about 10,000,000 feet. For this type the annual cut approaches the annual growth. Present practice is building up a reserve in the other types, notably the Chestnut-Oak type, and is maintaining present volume in the Oak-Hickory type. This fact is partly explained by the presence of large holdings of non-resident corporations and individuals on which no cutting is now going on. On the smaller individual holdings a larger percentage of the annual growth is being utilized, but in only a few areas (Rock Creek, lower Jones Creek, and lower Troublesome Creek) does the annual cut exceed the annual growth. This is not the result of any desire of the owners to practice sustained-yield management, *per se*, but is the result of action of economic forces

¹⁴ Holmes, J. F., and Bradfield, W. "A Study of Forest Conditions in Kentucky." Kentucky State Board of Agriculture, 1908.

operating over a long period. Poor transportation facilities, a depressed market, and a lack of appreciation of the potential value represented by the forest resource, have combined to keep production well below maximum capacity.



A typical portable mill in Knott County. This mill turns out $\frac{3}{4}$ -inch and 1-inch boards, 2x2-inch and 2x4-inch stock, and cross-ties. (Forest Service Photo No. 247043.)

Milling and Marketing.

Sixteen sawmill schedules were obtained, but only 13 of these had data complete enough to serve as a basis for analyses. It was impossible to get complete data from the large logging operations in the county, altho one company did furnish cost figures. Two of the portable mills which furnished schedules had been operating only a few days each month, and hence furnished no figures comparable with those from other mills.

Thirty-five portable mills were operating in the county in 1930. There were two large stave mills also, and one lumber company was operating on a large leasehold, for a permanent mill outside the county. These last three mills furnished about 35 percent of the total production. The small mills usually cut the owner's timber and do custom sawing for his neighbors. A few operators buy stumpage and manufacture lumber for sale

to the mines or railroads. Of the 16 mills visited in the four districts intensively covered by the survey, 9 owners held either timberland or stumpage, bearing a total of 6,000,000 board feet. Both stave mills and the non-resident mill were operating on leased timber rights.

Table 7 is a cost analysis of the 11 comparable portable mill operations. It is evident from this table that length of market haul is one of the primary factors determining the profitableness of the operation. For the 8 mills showing a net profit, the average length of this haul was $3\frac{1}{2}$ miles, while for the 3 mills showing a net loss the distance was 11 miles. The average cost per mile for the first group (A) was \$.91, and for the second group (B) was only \$.57. Yet the extra $7\frac{1}{2}$ miles of haul, plus certain other factors, increased the cost of production to \$5.31 per thousand board feet above the sale price. Evidently the group B mills were operating in a poorer grade of timber, as shown by the nearly \$4.00 lower selling price of their product. The cost of milling this poorer grade timber was greater, and skidding costs were increased by evident increase in length of skidding distance. All these factors combined to make the whole

Table 7. COST ANALYSIS, PORTABLE SAWMILLS

**Group A. Profitable Operations. Average for 8 Mills. Based on
M. feet, Board Measure**

Stumpage	Felling	Skidding	Milling	Hauling to Market	Miles Hauled	Over-head	Total Cost	Selling Price	Profit
\$4.31	\$2.31	\$4.12	\$5.52	\$3.19	$3\frac{1}{2}$	\$.14	\$19.59	\$23.12	+\$3.53

Group B. Unprofitable Operations. Average for 3 Mills

\$3.58	\$2.17	\$6.00	\$6.33	\$6.25	11	\$.15	\$24.48	\$19.17	—\$5.31
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Average for All—11 Mills

\$4.11	\$2.27	\$4.64	\$5.66	\$4.02	$6\frac{3}{4}$	\$.14	\$20.84	\$22.05	+\$1.12
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operation highly unprofitable. An average of all 11 mills showed a net profit of \$1.21 per thousand board feet or 5.8 percent on the total cost, hardly an attractive investment. The group A mills showed a net profit of 18 percent.

The figures obtained on stave mill operations vary so widely in all particulars of cost and selling price as to warrant suspicion as to their accuracy. They are not presented for that reason.

The market for export lumber is chiefly regional—to the mines in Perry and Floyd Counties, and to the two railroads in the same counties. From available data it appears that these mines and railroads purchase about 1,500,000 board feet annually. The staves usually are sold to jobbers thruout the United States, and many of them are exported to France and Italy for wine casks.

The lumber consumed locally is used mostly for new buildings and maintenance of present structures. No lumber is remanufactured in the county, nor indeed in this whole region, so far as could be learned. The manufacture of wood pulp is only a future possibility.

Present Ownership of Land.

Any analysis of land-utilization must discuss the present ownership of land and the trends of ownership in the future. Ownership of Knott County land, as of July 1, 1929, was as follows:¹⁵

	Acres	Percent
Non-resident corporate holdings—		
250 acres and over	48,371	21.3
Non-resident individual holdings—		
250 acres and over	13,969	6.2
State lands	2,500	1.1
Resident holdings—largely individual—		
250 acres and over	29,903	13.2
Holdings less than 250 acres—		
Largely resident	132,028	58.2
Total	226,771	100.0

It is evident that residents owning less than 250 acres form the largest group of land-owners, and control more land than all

¹⁵ Data from county tax-rolls, 1929.

other owners combined. The average size of resident-owned farms in the county is 107 acres. On 273 farms for which complete data are available, the total capital investment is \$2,629 per farm, of which \$2,267 is in realty (land, timber, buildings, mineral), and \$362 in personalty (livestock, machinery, household good, etc.)*) These figures indicate that the average farm enterprise, judged both by the size of farm and by capital investment, is small. This condition has been brought about largely by the subdivision of the original large tracts among heirs, for several generations. Counteracting this process has been the purchase by non-resident corporations of large blocks of both surface and subsurface acreage in fee, in the interest of developing the coal, oil, and gas. These holdings have increased slowly, but much of the best mineral land already has been acquired, and it is probable that the peak of such acquisition has been reached. One company, holding several thousand acres of cut-over land, is now anxious to dispose of its property, since the mineral does not justify development.

Non-resident individual holdings, totaling about 14 thousand acres, or 6 percent of the total area of the county, are held mostly for the minerals or timber. These holdings are not likely to increase, for the same reason as given for corporate holdings.

With the exception of State lands, the remaining area of the county (161,931 acres, or 71%) is in resident-owned farms, or in the county seat, as urban area. It is likely to remain so, unless a program of public land acquisition is effected.

Forest Income of Farmers.

On the 273 selected farms mentioned above the average annual net income per farm from all forest resources on the farm amounts to \$30.57. The total annual cash income per farm is \$360.00. Of this, \$173 is from labor off the farm, leaving a balance of \$187 for income from the farm proper. Of this balance the income from forests is 16½ percent, an appreciable proportion. In fact, this source of income ranks sixth

* From a preliminary analysis of the data on the incomes of Knott County cooperators, made by the Department of Farm Economics, Kentucky Agricultural Experiment Station.

among all sources for the farm proper. An additional source of income from forests is included in the \$173 from labor off the farm, but what the proportion is the present figures do not reveal.

The total income to local labor from the present forest industry in the county amounts to about \$98,500 per year. This figure is derived by multiplying the total annual lumber production of 6,614,000 feet by the labor costs involved in the production of each thousand feet. Table 7 shows the total cost to be \$20.84 for the average mill. Excluding stumpage, overhead, and equipment costs from this total leaves a balance of \$14.90 as the labor share of the total.

If industrial development were brought up to capacity; i. e., to complete cut of the annual growth, the income, based on the same ratio, would amount to over \$285,000 per year, or nearly three times the present total. It is extremely doubtful if the farming industry can show an equivalent labor income, either now or in the future.

The average farmer's capital investment in his timber is small, because taxation is not burdensome. Timberland, excluding the timber thereon, is assessed at an average rate of \$5 an acre, tho certain tracts are assessed as high as \$8. Timber is assessed at a nominal rate, depending on merchantability and location. An analysis of 150 such assessments shows the average assessment on old-growth timber to be \$2.50 an acre; on merchantable second-growth \$.90; on nonmerchantable second-growth and old-field stands \$.75. At the present tax rate of \$18.50 per \$1,000, the annual timber tax is but a few cents per acre. Thus, if the stand were all old-growth, the annual tax on timber and timberland would be but 14 cents. Cleared land has a wide variation in assessed valuation. Good bottomland usually is assessed at \$100 an acre. Steep pasture land may be assessed at the same rate as timberland. Other crop land is valued at from \$10 to \$20, depending on slope, condition, and location.

Forestry in the Economic Future of the County.

As shown in Table 1, 75 percent of the county is now bearing timber—a total of nearly 170,000 acres. According to the

1930 Census, 10,700 acres of this is woodland pasture. The Census also shows a decrease of 29,000 acres in farm woodland not pastured, an increase of 8,000 acres in woodland pasture, and a decrease of 5,000 acres in total crop land, during the last decade. These variations in land-utilization as of any given year are of no special significance under the system of land-utilization now in vogue. Of more significance is the increase in population. The population of Knott County in 1930 was 15,230, or 43 per square mile. (The area of the county is 354.33 square miles.) This is an increase of nearly 31 percent since 1920, as compared with an increase of but 8 percent for the preceding decade.

It has been stated (see section on Land Utilization) that the present system of land-use rotation eventually reaches a point beyond which it becomes economically infeasible, and that many acres of Knott County land have reached this stage. An increase of 31 percent per decade in population (most of which engages in agriculture) results in a more rapid exhaustion of soil fertility and thus increases the rate at which farming under this system is becoming unprofitable.

Since 75 percent of the county is forest land, a large part of the problem of land utilization is the proper handling of this area. Unquestionably the greatest physical need of the county is for better transportation facilities. At present, the only markets for timber products (other than for immediate local consumption) are located outside the county at distances of from 3 to 20 miles. Under present conditions the average mill must be located only a few miles from the market or railroad if it is to pay a reasonable profit on the cost of operation. Hence the mills must be located around the eastern and western boundaries of the county, leaving at least 70 percent of the forest area unutilizable except for the small amount of timber used on local farms. If the forests in the interior of the county are to be utilized economically there is need for roads over which lumber can be hauled at a lower cost than that now prevailing for this interior area.

Provided highway construction takes place in a reasonably short time, it should be possible to establish local industries for the remanufacture of lumber. The situation with respect to power, raw material, and labor is so favorable that manufacturers of furniture, veneers, novelties and wood-pulp should be able to compete in the national market with manufacturers located farther from sources of raw material and in regions of higher labor costs.

The manufacturers of furniture would want oak, beech, maple, gum and walnut; the veneer mills chiefly white oak, gum, cherry and walnut; and the novelty mills all these species and such others as hickory and red maple. These latter would also utilize much of the mill waste of the other manufacturers and trees which were unsuitable for high-grade products. Pulp mills would want a large supply of yellow poplar. With the exception of cherry and walnut, which occur in limited quantity, these are the species most abundant in Knott County.

Another and possibly more immediately realizable development is the opening up of the local supplies of coal, oil and gas. Atho the development of gas and oil will afford but small direct market for forest products, it may well have a profound effect on the industrial development of the county and great indirect effect on the lumber industry. There is every reason to expect that the coal will ultimately be developed and spur railroads built to handle the output. This, in itself, will provide an annual market for several million feet of lumber, in the form of cross-ties, mine props, carstock, cross-collars, and similar products.

Assuming that the development both of mines and of wood-using industries takes place, what bearing has it on the forest practice of the individual farmer or other owner of timberland?

First, and most important, it means that he must protect his timber from fire and overgrazing. This seems to be clearly recognized, on the whole. While there have been, as stated before, very few fires of serious proportions of late years, the evidence on the ground shows that at one time or another in the past fully 75 percent of the forest land has been burned over by severe fires. A large volume of timber has been rendered



A detailed study in land-utilization, showing four different stages of reversion of cleared land to forest. The narrow strip in the upper right-hand corner of the picture has been reverted for about 20 years. The triangular section at the extreme right, eight years. The field in the foreground, two years. The forest in the rear of the cornfield has never been cleared, but the larger timber has been culled out. The reproduction is largely oak and hickory. (Photo by courtesy of the Bureau of Agricultural Economics.)

defective by fire scars and subsequent rot. Because of the appreciation of the value of mineral resources, a realization has grown up of the danger of fire getting into the coal. In consequence, more determined efforts on a community basis are now made to extinguish all forest fires as soon as possible. This is a worthy effort and must not be allowed to lapse. There is undeniable truth in the statement, "Everyone loses when timber burns."

Overgrazing is not an important factor in forests at present. Only about 6 percent of the forest land is grazed, and that area by only a relatively few head of stock. Only in the old-field stands, particularly on steep slopes, is regulation of grazing a present necessity. On these tracts, even limited grazing is injurious, for it adds to the already large factor of erosion, and injures the trees by exposing their roots and scraping off the bark. In general, all old-field stands of established trees should be fenced against grazing. They are of far more potential value for timber production than for forage. The practice of land-use rotation now in vogue does not in any way necessitate pasturing these areas with cattle, sheep, or hogs, since abundant pasture

is available elsewhere for the limited number of stock in the county.

In the section devoted to a discussion of present land utilization, it was said that a change in rotational practice is a necessity. That such a change would upset the traditional practices of the people is not a bar to its inception if the progress of the county is desired. It is not in the scope of this report to suggest specific systems of crop rotation but, regarded from the forestry standpoint and in accordance with the frequently expressed opinion of farmers, the practice of clearing additional land for crops on steep slopes must be stopped. Already all the better agricultural land on these slopes has been made non-arable.

A preliminary economic analysis of 94 fields in the county indicates that on land of this type the period over which corn can be produced profitably is 10 years, after which production per acre falls too low to yield more than a very small return on costs of operation. Production on the steep slopes, under current expense of clearing and cropping, costs about \$31 per acre per year, while at the normal local sale price of corn (\$1 per bushel) the gross return is about \$35 per acre per year. Furthermore, these slopes can produce only an average of 6 crops in 10 years. The total net return, therefore, over a 10-year period is only about \$30, allowing 4 percent compound interest on the investment. To get the same return from timber, say yellow poplar, on the same site would require a stumpage value of \$7.20 per thousand board feet, which is only slightly higher than the current price. But if the owner kept this land in timber for a period of 20 years, the returns from the timber would exceed those obtainable from corn on the same site by many dollars. After 10 years, as stated, the returns on corn production become increasingly smaller, while those from timber become larger. Even at the end of the 15th year, the annual net return on corn is reduced to less than 50c an acre. After that, every year that the same land is used for corn means a net loss to the owner. Just the opposite is true if the land is allowed to remain in timber. Every year that the trees continue to

occupy the ground they increase in volume and quality until maturity is reached. Furthermore, if industrial development takes place, the stumpage value is almost sure to increase, while a proportionate increase in the value of corn cannot be assured.



A cleared field coming into yellow poplar, now averaging about 4 inches D. B. H., Lotts Creek. This type is rapidly increasing in the county. (Forest Service Photo No. 249147.)

Other factors are to be considered, among which erosion is of especial importance. With the land bearing trees erosion would be reduced to a small amount. Under cultivation, however, the erosion on a 40 to 80 percent slope is enormous, as the experience of the county abundantly testifies. Because of this much of the land once under cultivation is no longer arable, having been reduced to a stony loam approaching a gravel. These factors, decreased soil fertility, and increased erosion, and the greater net return from timber in the long run argue strongly for the retention of the land in timber and the abandonment of cropping on steep slopes.

The strongest objection to devoting the land to timber is that the land will produce no annual cash income if in timber, as it does if in corn, and that the farmer must have means of support for himself and family while his timber is growing. The answer is that he will make more money in the long run

from timber than from corn, and that he must get his annual income from sources other than 40 to 80 percent slopes; from more intensive cultivation of bottomlands and lower slopes; from mineral leases, and, as he does now, from labor off the farm, for which more time would be available with reduced crop acreage. It may also be argued that timber values are a future possibility, while corn values are a present actuality. Unless the land is devoted to timber, however, in another two decades it will yield no income, because per acre production of corn on this type of land will have fallen too low for economic cultivation.

A decrease in crop acreage naturally would be followed by an increase in forest land. It is on the forest land that the real problem of land utilization is centered. It will do no good to increase merely the area of forest land. Such land must be managed to yield a return on the investment. This does not mean that the individual farmer alone, owning a small forest area of 50 to 100 acres, can afford to practice sustained-yield forestry, unless an immediate market is located in close proximity. There are, however, certain practices he can follow. The first of these is prevention and control of fire and overgrazing. Second, he can refrain from clearing land on steep slopes, or any slope more than $1/3$ the distance up the slope from creek level, and retain this land in timber. Third, he can cut what timber he needs for farm maintenance and firewood from trees that are defective or overmature, from trees that are interfering with the growth of more valuable species, and from trees of inferior species, thereby improving the quality of his stand and enhancing its value. Next, he can make thinnings, particularly in his old-field stands, when the market is favorable for the sale of small timber; practice pruning of poplar and black locust; remove overmature and defective trees; and in these ways also enhance the value of his holdings.

Undoubtedly marketing conditions would be improved by the forming of cooperative marketing associations, or some similar organization. In the first place, larger quantities of timber could be offered for sale at one time, permitting a mill to operate

from one set-up for a longer period. Second, prices could be maintained at higher levels.

On large holdings, particularly those owned by corporations, there is opportunity for intensive forest management. Management of a given tract must be governed by conditions obtaining thereon. To obtain the data necessary for making a management plan involves a detailed, careful study of the tract to determine the kinds, size, age, rate of growth, amount and quality of the timber, and its distribution; the size of the area; timber on contiguous tracts; transportation facilities both within the tract and between it and the market or railroad; best methods of logging, and length of cutting cycle; costs of operation, stumpage, and selling price; available markets, both present and potential, etc., all based on the primary purpose of management. A few general rules, however, can be laid down. The ideal of forestry is sustained-yield management, by which is meant the practice of so regulating the annual or periodic cut that it does not exceed the annual or periodic growth. For example, if, on a 1000-acre tract, the annual growth is 175,000 board feet, then the average annual cut would not exceed this amount. It may be taken out but once in 10 years (i. e., amount to 1,750,000 board feet), but the average per year would not exceed the annual growth. This assures a perpetual operation, since the basic capital is never used, but only the "interest" is expended. It is not generally feasible on small tracts unless an immediate market of steady demand is located nearby. On the large corporate holdings in Knott county, however, it is entirely practicable. Were any such operation planned in the county it would be essential, after completing the working plan, to improve the quality of the stand by harvesting the over-mature and defective trees, and by removing excess volumes in any one age-class, with the ultimate purpose of obtaining a stand where each age-class will have approximately the same volume of timber when mature. This would make possible an immediate return on the investment, while at the same time it would put the stand on the basis for sustained-yield management. Thereafter only the periodic growth would be removed periodically. After the tract had

been cut over once under this plan, the area first logged over would be ready for a second harvest. It is obvious that successful operation of this plan requires the services of a trained forester to insure the accurate working out of details.

The corporations now owning timberland in this county are primarily interested in the mineral resources. Inasmuch as they own a total of nearly 50,000 acres of surface, however, it is desirable that they get some return on the timber. They might, of course, sell the stumpage alone and merely retain the land and subsurface rights. Bare land produces no income, however, and the majority of the corporations wish to retain the timber to be used in connection with the mining. The scope of present forestry practice and the general attitude of these corporate or individual owners of large tracts will be discussed later in this paper. There can be no question but that it would pay in cold dollars and cents for the owners of timberland of 1,000 acres and over to organize their forests on a basis which would permit future sustained-yield management. There is also the ethical side—their duty as holders of over 21 percent of the area of Knott County so to manage their property that the best interest of the whole county will be served.

Public Land Acquisition.

If the development and practices described in the preceding section do not materialize, the only alternative seems to be an immediate expansion in public land ownership. To date only 1.1 percent (2,500 acres) is in State hands, under control of the University of Kentucky. There is an unquestionable opportunity here for the State to add to its State forests at small cost, a development to be strongly recommended. Several corporate holdings, totaling over 10,000 acres, and excluding subsurface rights, are believed to be available at not over \$4.00 per acre. Knott County lies outside of the area within which federal forest purchases are contemplated under the present program. Sooner or later, however, the program of federal acquisition may be expanded, and this county may come within its scope. By whatever agency the acquisition is made, it would be to the ad-

vantage of the county to have several thousands of acres in public domain. It may become an unavoidable necessity.

Present Scope of Forest Practice.

All but one of the corporate and individual owners holding surface in fee of 800 acres or more furnished information regarding their forest policy. Of these 11 owners, 10 own both land and timber, and the other owns stumpage rights only. One of the 10 has no salable timber on its property.

The attitudes of these owners toward their timber vary widely. All but one are corporations whose chief business is mineral development. One company only is practicing forestry at present. This corporation owns about 1,160 acres in Knott County, but its holdings in the Plateau region total over 75,000 acres, of which 20,000 acres are in southeastern Kentucky. It has registered its Kentucky tracts under the State District Forest Act and employs regular fire guards and wardens. It is not now cutting on any of its own tracts, but plans to do so after management plans are completed. These plans aim to log off the over-mature and defective timber under a system that will protect young growth and reproduction and eventually put the stand under sustained-yield management. It is also planning to reforest its cut-over lands and abandoned farm lands, using such species as poplar, locust, and shortleaf pine. This is indeed an encouraging start toward the treatment recommended in the preceding sections.

Another company is the largest owner of surface in the county—over 13,000 acres, with an adjoining tract of 23,000 acres in Breathitt County. Its land was purchased with a prior timber contract held by a lumber company which has since logged off most of the salable timber. Faced with this large acreage of cut-over land, this company is now developing plans for the forest management of its holdings. On the large individual holding, the timber is to be cut only under a contract requiring the lumberman to protect young growth and reproduction, and to cut no trees smaller than 14 inches on the stump.

A third company, having no timber of merchantable size on its land, is disposing of surface to farmers for agricultural use. Its holdings were old-growth, over-mature stands, on which loss for defect and windfall exceeded growth, and the company therefore sold the timber as soon as this fact was learned. Had it been possible to draw up a management plan, it is very probable that a system could have been worked out for retention of the land, the harvesting of the over-mature timber, and management of the young growth left after logging.

Altho the tax on timber never amounts to more than 20 cents per acre per year, several other companies intend to sell the timber as soon as possible "to avoid high taxes." Where the interest is solely in subsurface rights, there is, perhaps, some justification for this attitude, but even then it is true that the development of minerals, especially coal, would be made more profitable by the presence on the company's property of a stand of timber for mine use. Several mining corporations are reserving their timber for this specific purpose, and are coming to the conclusion that the practice of at least an elementary form of forestry is good business economy.

With the exception of the one company first mentioned, fire prevention and control and grazing control are centered in tenants living on the property. One of the prerequisites of tenancy is that the tenant act as fire guard. By only one company, however, so far as could be learned, is the tenant required actually to patrol the property. The others require him to put out any fire that starts as soon as he discovers it. Since much or all of his time is spent in tending his own leasehold, however, the actual amount of fire protection he affords is small, as a fire may gain considerable headway before being discovered. To be sure, this is far better than no protection at all, but it would seem the part of wisdom to require all tenants to patrol the property during times of special hazard.

Among smaller individual holdings, there is only one instance, so far as known, of the practice of forestry. This is on a 5-acre tract of old-field yellow poplar on Bear Branch of Jones Fork of Beaver, in District VI. The farmer-owner has

fenced this area against grazing, built a partial fire-line around it, removed all species except poplar, thinned out the stand, and pruned the trees up to a height of about 10 feet. To be sure, the thinning was not so intensive as it should have been, since a large number of defective trees were left. Nevertheless, this stand is putting on a *net* increment of 478 board feet per acre per year as against an average for all such stands of 430 feet. Had the thinning been completed, it probably would have an annual increment of 600 board feet per acre. The thinning was done at odd times and at no cost other than the owner's labor. The pruned trees will produce a much better grade of clear lumber, worth at least \$7.50 a thousand feet on the stump. This is obviously a paying investment for the owner, and should serve as an example for other farmers with similar stands of trees.



An old-field stand of yellow poplar after thinning and pruning. This is the stand referred to on page 35. All old-field poplar stands should be similarly treated. (Forest Service Photo No. 250871.)

This resume of forest practice in the county indicates that forestry is being recognized by both corporate and individual owners. While the actual practice in the field has but just begun, the interest shown by both classes of owners is a good

augury for the future. This movement must continue if the forests are to yield their due proportion of county income.

Economic Future of Knott County.

In summarizing the facts presented and the recommendations made herein, it will be seen that they lead to three alternatives for the forest land of the county :

First, continuation of existing conditions of limited utilization and lack of management, the result of inadequate transportation facilities and consequent lack of appeal for industrial development, and very elementary fire prevention and control.

Second, the construction as soon as possible of adequate roads—and perhaps a railroad—which, in turn, would lead to the investment of outside (or local) capital in the development of mineral resources and the establishment of wood-using industries for the manufacture of furniture, veneers, novelties and pulp.

Third, for the State or Federal Government to take over the bulk of the forest area.

It is obvious that the second alternative—progress and development—is the one most likely to appeal to the majority of the people. It is true that this will be the most costly, judged by initial investment. It will be the most profitable, judged by ultimate returns. In summarization of the steps considered necessary to bring this condition to pass, the following are submitted :

(1) Development of a road system which would make possible the economical transportation of timber to market.

(2) Decrease in crop acreage by abandonment of steep slopes and ridges to forest, and a change in rotational practice by more intensive cultivation of bottomlands and lower slopes. This phase is being dealt with fully by other participants in this study.

(3) Bringing in outside capital, or utilization of local capital, for the development of mineral resources by opening mines, and drilling for gas and oil, and the development of

timber resources by the opening of local industries for the manufacture of furniture, veneers, novelties and wood pulp.

(4) Formation of farmer-owned and operated marketing associations for forest products, including timber. In this connection it might be necessary to employ at county expense (or by arrangement with the State Forest Service) an extension forester to act as an adviser on management.

(5) Practice of fire protection and grazing control; improvement of forests by harvesting of over-mature timber, by thinning and pruning; and, on large areas, the practice of sustained-yield management.

(6) Increased acquisition of public domain by the State or Federal Government as State or national forests or reserves.

It is not within the scope of this report to discuss costs and methods of financing. Such details must be settled by the county itself, in cooperation with the State. Nor is it implied that the six steps outlined are a panacea for all the economic ills of Knott County. This report is primarily concerned with the forest situation, and leaves to other agencies the analyses of agricultural and sociological conditions and recommendations for their improvement and amelioration. It is believed that the developments here suggested are possible of accomplishment and that, if completed, they will solve the forest problem of this county, which, from the standpoint of gross acreage and ultimate value of resources, is the major concern in land utilization therein.

APPENDIX

Table A. PRELIMINARY YIELD TABLE—OLD-FIELD YELLOW POPLAR¹⁸

Age	Board Feet						Cubic Feet						Age
	Gross Volume			Mean Annual Increment			Gross Volume			Mean Annual Increment			
	Site			Site			Site			Site			
	Good	Med.	Poor	Good	Med.	Poor	Good	Med.	Poor	Good	Med.	Poor	
10	2,700	900	200	180	60	10	300	200	100	30	20	10	10
15	5,800	2,900	1,000	290	150	50	600	400	200	40	20	10	15
20	8,800	5,000	2,500	350	200	100	1,200	600	400	60	30	20	20
25	12,000	7,200	4,200	400	240	140	2,000	1,000	600	80	40	30	25
30	15,300	9,200	5,800	440	260	160	2,800	1,500	1,100	90	50	40	30
35	18,500	11,500	7,600	480	290	190	3,600	2,000	1,600	100	60	40	35
40	19,100	11,500	7,600	480	290	190	3,600	2,600	2,000	110	70	50	40
45	23,100	14,500	9,600	510	360	210	4,300	3,200	2,300	110	70	50	45
50	27,100	18,500	11,900	540	370	240	5,100	3,800	2,700	120	80	50	50
55	31,200	22,800	14,300	570	410	260	6,500	4,400	3,000	120	80	60	55
60	35,500	27,000	16,700	590	450	280	7,200	5,600	3,400	120	80	60	60

¹⁸ Based on 9 half-acre plots in Knott County, Kentucky. Cubic volume is entire stem less bark. Board-foot volume is total volume, excluding a one-foot stump and to a 5-inch top, diameter inside bark, by International $\frac{1}{8}$ -inch Log Rule.

Table B. PRELIMINARY YIELD TABLE—OLD-FIELD
OAK-HICKORY TYPE¹⁷

Age	Gross Volume (Per Acre)		Mean Annual Increment (Per Acre)	
	Board Feet	Cubic Feet	Board Feet	Cubic Feet
15		500		30
20	600	600	30	30
25	2,100	800	80	30
30	3,100	1,000	100	30
35	4,100	1,200	120	40
40	5,100	1,600	130	40

¹⁷ Based on 5 plots in Knott County, Kentucky. Site—Medium.

